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WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

No. 106

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INDUSTRIAL TECHNOLOGY

TRANSPORTATION

ELECTRONICS

PHILIPS/RTC PRODUCES WORD-SYNTHESIS CIRCUIT

Paris ELECTRONIQUE ACTUALITES in French 12 Mar 82 p 13

[Text] It is the turn of Philips/RTC (Radiotechnique Compelec) to enter the field of automatic speech processing with a prototype speech-synthesis circuit, the MEA 8000. Using a voice box model (formants + LPC), this non-memory circuit is primarily a microprocessor peripheral designed typically for integration into microcomputers.

The MEA 8000 circuit is presented in a 24-pin DIL package, using N-MOS technology with a single +5 V supply. It is based on a mixed word-synthesis technique, since it combines the method of formants with LPC (linear prediction coding). The method is primarily intended to achieve a good compromise between reproduction quality and storage economy.

The electronic model used by Philips is relatively simple: it consists of a two-state wave generator which mixes periodic signals (fundamental to voiced sounds) and white noise (non-voiced sounds), feeding a cascade of four resonators (in fact an eighth-order digital filter). Each resonator is programmable on two parameters, resonance frequency and bandwidth. Linear interpolation occurs at each parameter reset, namely at a rate of 8 kHz. The output sampling rate is 64 kHz, reducing the requirements of the external analog filter.

Each group of parameters is supplied by a 32-bit word (accessible from an 8-bit bus), providing a basic word overlay whose duration is programmable (8, 16, 32, or 64 ns). The signal amplitude is also programmable.

Memory Efficient

In this respect, the Philips seems particularly interesting because of its flexibility, since all its coding parameters are programmable. In particular, this characteristic makes it possible to synthesize non-voiced "sentences."

This circuit is probably also among the most memory-efficient on the market, even though it has no internal ROM. Indeed, in its simplest configuration with an MEA 8000 circuit and a microprocessor with 2 kbytes of internal ROM memory, it can produce 15 seconds of speech, or an average of 20 to 25 words. Beyond this, it typically requires 1000 bits of ROM or EPROM memory for each additional second of speech.

The MEA 8000 is primarily designed as a microprocessor peripheral, and the main Philips target is clearly the market of synthesis systems integrated into microcomputers (or into cards where the microprocessor already controls other functions). It uses less than 1 percent of microprocessor time.

In France, the practice is for the user to provide RTC with a cassette containing the required sentences. Philips (RTC beginning in September) then proceeds to analyze them, encode them, and burn them into an EPROM.

After customer testing, iterations are still possible for quality improvement.

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THOMSON-EFCIS OPENS PLANT FOR MANUFACTURE OF ULA'S

Paris ELECTRONIQUE ACTUALITES in French 19 Mar 82 pp 1, 15

[Article by JPDM]

[Text] One year ago, the components branch of Thomson entrusted EFCIS with the responsibility of establishing a custom circuit department, based essentially on the customization of prediffused circuits, supported by a unit for designing and fabricating these circuits, separate from the actual plants of the integrated circuit (bipolar) division of Thomson-CSF, located at St. Egreve, near Grenoble, and from the EFCIS company (65 percent Thomson-CSF), located in Grenoble itself (see ELECTRONIQUE ACTUALITES, 27 March 1981). This unit is now completed, and by April will have installed all the staff responsible for the various phases of circuit design. Its name is DCS (Special Circuits Division) and it falls entirely under the responsibility of Thomson-EFCIS, the name henceforth representing not only a brand, but an entity combining joint administrative, marketing, sales, and quality control staffs. Beginning in April, DCS will offer prediffused C-MOS's with metallic grid and 144 cells (720 pairs of transistors), or 300 cells (900 pairs), as well as a 400-component linear prediffused wafer, known as "polyuse."

Before the end of the year, they will offer five C-MOS, metallic grid arrays, five 5 micron/10 ns C-MOS silicon grid arrays (up to 968 cells), and a 3.5 micron/5 ns C-MOS silicon grid array. A sub-nanosecond bipolar array will also probably be offered at that time.

A Service Adapted to All Needs

Thomson's objective in installing this unit is to offer a custom circuit service independent of its bipolar and MOS plants, so that the latter will devote themselves solely to the mass production of standard and innovative circuits. The type of circuit offered will depend on each user's needs: prediffused wafers when the quantities requested are small and lead times are short, pre-characterized (or catalog) circuits when the quantities exceed 20,000 to 50,000 pieces and the lead time can be as long as six months, and finally, pure custom circuits when the quantities involved are several hundred thousands. Of course, the customized arrays or the mass production diffusions will be provided by the MOS or bipolar plants; but they will not go beyond this. All the service aspects will remain the responsibility of DCS. The service will cover the design, simulation, and

generation of test programs if the user does not want to perform them himself. It will also cover the fabrication of mask generation tapes, circuit metallization and etching, as well as testing and packaging for small runs. The masks will be made at the St. Egreve plant, which is well equipped in this respect.

Five Families of Prediffused C-MOS's

Thomson-EFCIS's market studies show that 70 percent of the DCS activity will be oriented toward prediffused circuits. A large program aimed at creating arrays for all needs has been formulated. Technologically, these arrays will of course make use of the existing and future facilities of Thomsons-EFCIS' bipolar and MOS plants.

Three types of arrays are being studied: C-MOS, digital bipolar, and analog bipolar. C-MOS is currently the most advanced family, since it is the one that is most adaptable to short-term needs. This family is itself subdivided into five sub-families, depending on type of application: 3-17 V/15 ns aluminum grid for arrays to replace C-MOS 4000 installations; 5 micron, 3-12 V/10 ns silicon monolayer grid for circuits designed to replace TTL-LS logic circuits; 3.5 micron, 3-12 V/5 ns silicon monolayer grid to replace TTL-S circuits; 3.5 micron, 3-10 V/3-4 ns double layer silicon grid to replace 10K ECL-compatible TTL-S circuits; and finally, within two to three years, a double-layer silicon grid family, N-package, 2 micron, 3-10 V/2-3 ns, to replace 10K ECL assemblies.

Introduction dates have been set for the first two C-MOS families: two 144- and 300-cell, aluminum grid technology models have already been offered; they will be followed in June by a 120-cell model, in July by a 420-cell model, and in September by a 180-cell model.

In the 5-micron monolayer silicon grid technology, a 640-cell (1920 pairs of transistors) model will be offered in June, a 288-cell one in September, followed by 968 cells in October, 448 cells in November, and 192 cells in December. For these two families, users will be able to use a topologic and simulation catalog to design their own arrays.

Introduction of the first 3.5-micron silicon grid array is planned for November, with a model of about 1000 cells; the family will cover composites of 300 to 1500 cells. The introduction of the first 3.5-micron silicon grid with two layers of metallization, is in turn planned for May 1983, with a model integrating about 1400 cells. The family will cover 400- to 2200-cell circuits.

The first linear bipolar offering will be an array of 400 components, called polyuse, which has been used by the various divisions of the Thomson group for three years. In addition, DCS is currently working on the definition of a model known as 2 GHz (the transition frequency of the transistors obtained on an HF line available in St. Egreve), which will be used to implement circuits operating up to 600 MHz. This array should be introduced during 1983.

In digital bipolars, it will be decided between now and April whether DCS will make a second source ECL array from an existing array or an original ISL.

Lead times for obtaining the first 20 samples of customized prediffused devices will obviously depend on the services provided. For instance DCS will require two months to provide a design layout from circuit specifications if the user does not want to do it himself. Integration of the layout with mask design will require an additional month and one-half if DCS is assigned the task. Finally, fabrication of the 20 initial, good, tested, samples will require eight weeks after mask design, which is one of the shortest lead times available on the market.

For manufacturing, a period of three to four months can be expected for establishing final test programs, process specifications, and quality control. One hundred prototypes (not samples) will then be available for delivery.

Precharacterized C-MOS's in Late 1982

As we have seen, DCS will also offer catalog circuits (precharacterized circuits). The division has already established a catalog of about 40 standard TTL-LS cells based on the St. Egreve bipolar unit catalog. Late in 1982, an MOS and C-MOS catalog will be compiled based on the EFCIS MOS unit.

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RTC DEVELOPS TRIANGULAR-CELL D-MOS TRANSISTOR

Paris ELECTRONIQUE ACTUALITES in French 19 Mar 82 p 16

[Article by J. P. Della Mussia]

[Text] RTC (Radiotechnique Compelec) just disclosed the structure characteristics of the D-MOS transistor that the company has been studying for several months. This structure is based on triangular cells (rather than hexagonal, as in the case of Siemens or IR); according to RTC, this would make it possible to reduce the output resistance of the D-MOS with respect to existing structures, thanks to "an optimization of the channel perimeter/useful area figure of merit."

From our own comparisons with the International Rectifier (IR) industrial devices, the reduction in output resistance obtained by RTC in their laboratories is of the order of 30 percent; this is a significant amount, which for a given power and voltage drop, can result in an equal 30 percent reduction in chip area. Such a reduction plays a very important role in manufacturing yields and therefore in costs (which can then be reduced by more than one-half). RTC could thus benefit from a non-negligible advantage when it decides to manufacture this device (the date has not yet been fixed), at least if the laboratory characteristics can be duplicated in industrial production, and if in the meantime the competition does not begin to sell improved versions of their current transistors.

100 V/0.15 ohm/9 mm-square D-MOS

The device presented by RTC for evaluation is a 9 mm-square D-MOS that can carry 100 V, with a typical series resistance of 0.15 ohms at 25 degrees C. Its characteristics are: 450 pf input capacitance, 200 pF output capacitance, 50 ns turn-on time, and 130 ns turn-off time. We compared these characteristics with those of its closest models in the IR line, namely the IRF 530 100 V/0.14 ohm typical/13.25 mm-square, and the IRF 520 100 V/0.25 ohm typical/8.04 mm-square.

In selecting a D-MOS model, the user first selects a power level and voltage drop at a given voltage. He thus selects a series resistance. In this case, the reference model must be the IRF 530, since its typical resistance is nearly equal to that of the RTC model: the gain in area is then nearly 30 percent. But the other characteristics, in particular for capacitances, are those of a 9 mm-square chip, and therefore very favorable for the RTC device. In particular, the typical input capacitance of the IRF 530 is 700 pF, and its output capacitance 300 pF. On the other hand, the response times of the IRF 530 are better overall than those of the RTC D-MOS: 80 ns for the turn-on time and 80 ns for turn-off time are typical. This is probably due to the very long channel required by the French design.

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ELECTRONICS

FRENCH FIRMS EXHIBIT SEMICONDUCTOR MANUFACTURING EQUIPMENT

Paris ELECTRONIQUE ACTUALITES in French 19 Mar 82 pp 1, 21

[Article by JP Della Mussia]

[Text] Zurich--Semicon 82, the major European event for semiconductor equipment manufacturing, held this year from 9 to 11 March, will have been unquestionably marked by a strong French participation among the exhibitors. Their presence was all the more noteworthy since the equipment offered by Cameca, Euromask, CIT-Alcatel, and Riber, covered all the key elements in the semiconductor fabrication chain, with the exception of automatic welding machines.

Generally speaking, no startling announcement was made, the leaders in the field--most of them American--reserving their unveilings for Semicon/USA, which is held in May. The event attendance remains the same (4000 visitors in 1980, 3500 in 1981, and 4000 this year), but the number of exhibitors is still increasing: it reached 250 this year, after having passed the 200-mark last year. In terms of trends, progress seems to have stopped in two areas: after having indicated their interest in 5-inch wafers last year, users are finally ordering equipment for 4-inch wafers this year, to eventually become compatible with 5-inch material. On the other hand, interest in direct electron lithography on wafers has dropped, in favor of wafer steppers and 1/1 projection aligners, at least for the generations of HMOS II/III integrated circuits, which are the substance of current investments.

And finally, the last notable trend is that in recent years the Europeans have reacted to their weakness in fabrication equipment, and now offer many original machines.

Wafer Stepper Versus 1/1 Aligner

The great news therefore, at least for the French, was Euromask's (Matra Group) presentation of its first wafer stepper, right at the company's exhibit. This machine has elicited great interest, especially since the first unit is to be delivered in a few weeks. Cameca (Thomson-CSF) also showed (but only on displays) its first wafer stepper, in direct competition with Euromask's. The first unit should also be delivered in a few weeks, which will lead to sales arguments from both, undoubtedly leaving the eventual buyer in a quandary.

The task will be a difficult one for the two companies, since GCA, which is number one in the world in this field, is also preparing wafer steppers with characteristics similar to those of the two French companies. Moreover, Perkin Elmer, the spoil-sport of the gathering, presented its 1/1 projection aligners, the Microlign 300 and 500, which use a different and simpler principle than that of the other machines. They are appropriate and more powerful for producing very large quantities of H-MOS II or H-MOS III circuits.

From all these presentations, potential users concluded that for the short-term mass-production of H-MOS II circuits, the Perkin Elmer approach is the most tempting at face value. But all the bets are not in: all these machines must prove themselves, and the French companies stand a good chance if they maintain their specifications and lead times. To summarize or be realistic: for the French its either midnight oil or failure, at least on the international market.

The situation is different for CIT-Alcatel with its GIR 200 etching machine (see ELECTRONIQUE ACTUALITES, 4 December 1981). All the potential users showed a lot of interest, without reservation, at least for etching polycrystalline silicon, and potentially silica (the work on aluminum etching is not sufficiently advanced to judge). CIT-Alcatel thus has all the opportunity to satisfy many orders in 1983.

And finally, the French company Riber (division of Instruments SA) also exhibited at Semicon for the first time. The company is well known for its molecular beam epitaxy (MBE) machines since it covers 60 percent of the world market in this field. At present, MBE is used primarily for III-V compounds (GaAs type); it is also beginning to be used for II-VI compounds. Two groups in the world are now studying this process for application to silicon (Riber and Bell Labs). The principle should make it possible to obtain epitaxial layers of excellent quality at a cost which still remains to be determined. Production of these machines for silicon could hardly occur before one or two years.

Many other French companies exhibited at Semicon for the first time, but their equipment did not have the "key equipment" nature of the companies mentioned above.

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FRENCH LITHOGRAPHIC MASKING MACHINES CLAIMED BEST IN WORLD

Paris ELECTRONIQUE ACTUALITES in French 19 Mar 82 p 22

[Article by JPDM: "What Lithographic Masking for Tomorrow's Integrated Circuits?"]

[Text] Two technologies for lithographic masking machines are currently competing on the market for H-MOS II circuits, and to a lesser extent, for H-MOS III: wafer steppers, which so far are exclusively used for printing patterns up to 2.5 microns, and 1/1 projection maskers. The first type projects the photo of a mask at a scale of four or ten on the surface of a silicon slice 10x10 mm-square for instance, and repeats this photo several times to cover the surface of the slice. The second type uses a mask at a scale of one, and prints the slice in a single operation. Because it is difficult to improve the definition-times-covered field product for objectives, it is preferrable to reduce the field to obtain the best possible definition and precision in mask superimposition.

Which explains the market success of wafer steppers for H-MOS II circuits, where GCA is a world leader. The French companies Cameca and Euromask are also using this approach.

Perkin Elmer, on the other hand, has always been the world leader for 1/1 projection maskers, which are simpler and more rapid than wafer steppers, and which today are almost exclusively used for H-MOS I circuits. But as we have seen, optics cannot be rapidly improved both in definition/precision and field coverage. The company therefore had to push technology to the limit, particularly in resorting to far-ultraviolet, in order to meet the requirements of H-MOS II (these machines will undoubtedly be inadequate for H-MOS III because of superposition errors). As a result of their very simple principle, the 4- and 5-inch machines that are being introduced have an announced production rate (100 slices per hour) that is three times higher than that of current wafer steppers, and two times higher than that of the new generation wafer steppers. Moreover, they are 30-50 percent cheaper. They could therefore win the game if they keep their promises in automatic operation. But as we have mentioned, the technology is being pushed to its utmost limits, and all the results are not yet in.

Perkin Elmer is doing its best against the attacks of wafer stepper manufacturers: "Eventual dust on masks is reduced with wafer steppers, but it is still there"; "when you say 40 4-inch slices per hour, you actually do not go beyond 25, and even less, in automatic operation"; "slice planarity does play a certain role, but we have a system which measures local distortion and creates a variable magnification; in any case, you need very good substrates"; "our new 300 and 500 maskers have the advantage of compatibility with the models 200 that are found everywhere; yours don't." On the other hand, wafer stepper manufacturers point out that the 300 and 500 machines need masks of such high quality, that they have to be produced on an electronic masker. Perkin Elmer does not deny it, and in fact offers its own electronic masker (which costs 13 MF!). And finally, wafer stepper manufacturers stress that a local readjustment is performed before each exposure with their machines.

Cameca: 60 to 80 Slices per Hour

Cameca asserts that its ARW wafer stepper, the first unit of which will be delivered within a month to the Integrated Circuits Division of Thomson-CSF, is the fastest on the market: 60-80 four-inch slices per hour in automatic operation, for an area coverage of 10x10 mm-square (60/hour guaranteed). Cameca stresses that its machine does not require any time to be placed in operation, that it has a superposition error of 0.1 micron, a useful resolution of 1 micron (0.8 micron limit), and absolute alignment through the objective. The company explains that the speed of its machine derives from its powerful light source (1000 W), its superimposed grid alignment system, and its autofocus, which is performed by three pneumatic sensors independently of slice surface.

Cameca has launched the fabrication of five ARW wafer steppers, and envisages the production of 15 in 1983, thanks to an investment of 20 MF in its facilities. A small production unit will be created in parallel (the site has not been selected); it should begin operations by the end of 1983. While the short term production goal is reasonable, it becomes ambitious for 1986: 80 machines/year (at a cost of 3.5 to 4 MF each). Cameca is presently setting up a demonstration laboratory at Courbevoie, which should be ready at the end of 1982. (A temporary laboratory will be opened in Corbeville in April).

Euromask: Like Cameca

Euromask (99 percent Matra subsidiary) officially announced in Zurich its Eurostep 2000 wafer stepper. Although it uses completely different technologies, the announced specifications are alomst identical to those of the ARW: 50 slices/hour for 7x7 mm-square squares in automatic operation; useful resolution of 1-1.5 microns (0.7 microns over the entire field with careful alignment); 0.1 micron positioning increment. Euromask explains that the speed of its machine results from rapid table movement (the table is made of a composite and weighs only 12 kg), short exposure thanks to an original light source adapted to the objective, and a prealignment that is performed during exposure of the preceding slice. In addition, Euromask points out that the alignment microscope is integral to the field definition device; alignment is thus performed at each level, on new patterns if necessary, gaining 100 ms per operation. The Eurostep 2000 automatically changes its reticle in 3 seconds.

Three machines are being assembled and tested at Euromask. The first will be delivered to HMS, the second to CNET, and the third will be used by Euromask for evaluation. Orders are currently being taken for delivery next November. The industrial production phase will in fact begin in September, in a new plant in Maleville, near Nantes. The company's investment in machinery and buildings is of the order of 30 MF.

Euromask hopes to sell six machines (in addition to the three already produced) by the end of 1982; the production capability in 1983 will be 30 machines.

For the future, Euromask is working on a laser beam reticle generator which will be less expensive ($600,000) than an electronic masker. The world market would be 300 machines.

GCA: Toward 0.7 Microns

GCA is not idle either. The company has just raised the speed of its machine by 40 percent, by improving its light output and mechanisms, and hopes to raise it by 70 percent for the year 1982 as a whole. CGA vice-president Bill Tobey would rather not give definite figures because "there are too many parameters involved." The company is also working on improving definition. "The adoption of Zeiss optics with a magnification of four, will enable us to achieve a 1.1 micron definition for a 10x10 mm-square area. In 1983, we hope to reach 0.7 microns for 7x7 mm-square squares, with a magnification of ten." There are other wafer stepper manufacturers on the market, the best known being Optimetrix, and more recently, Philips and Censor.

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RTC COMPETES FOR ULA MARKETS WITH LINE OF FAST ECL CIRCUITS

Paris ELECTRONIQUE ACTUALITES in French 5 Apr 82 p 20

[Article by J. P. Della Mussia: "RTC: Prediffused ECL Circuits Up To 2,200 Gates/ 0.35 NS"]

[Text] RTC [Radio Technique Compelec] has just announced a line of prediffused ECL [emitter coupled logic] circuits rated as among the world's highest-performing from the standpoint of speed, and certainly the one offering the best figure of merit. This line of cell arrays, called its ACE line, presently includes a 600-gate (24-cell) and a 900-gate (37-cell) model. A 1,400-gate (60-cell) version will be available in September, to be followed in the first quarter of 1983 by a 2,200-gate (100-cell) model, and 1 year from now by a 1,256-gate (48 cells plus a 256-bit RAM) model.

For all these arrays, the energy consumption per gate is 2 to 3 mW for a speed of 0.35 ns, resulting in a figure of merit of only 1 pJ [pico-Joule]. By comparison, a low-power 10-ns CMOS [complementary metal oxide semiconductor] consumes 100 μW per gate, for a figure of merit also equal to 1 pJ.

A Mushrooming Market

Contrary to predictions by the makers of prediffused devices who are locked into the CMOS, I^2L [integrated injection logic] and STL [Schottky transistor logic] technologies, the market for very fast prediffused ECL circuits should mushroom over the next few years, and essentially in the United States. This market is all the more attractive to ECL makers, in that there are so few of them worldwide as compared to manufacturers specializing in the slower technologies (Plessey, Ferranti, Siemens and RTC in Europe; essentially Motorola and Fairchild in the United States; mainly Hitachi, Fujitsu and NEC [Nippon Electric Company] in Japan).

Three market niches in particular are now opening up: In data processing, concurrently with the traditional CPU [central processing unit] market, the market for control of fast peripherals is developing; in instrumentation, three markets are opening up: That of acquisition probes for VLSI [very-large-scale integration] testers, that of high-speed oscilloscopy, and that of 16- or 32-channel logic analyzers.

Concurrently with the development of the foregoing markets in the United States, a telecommunications market will be opening up in Europe, and especially in Germany: That of TV-, stereo-, and other channel multiplexers whose bit rates will exceed 140 Mbits/sec, and the first uses of which are planned for the period 1983-1985. A fundamental change is thus taking place for ECL circuits, in that large computers will no longer provide, in the future, the principal market for very fast prediffused circuits.

Although the world market for ECL memories is currently dominated, to the extent of 45 percent, by Japanese companies (unfortunately for Fairchild, RTC and Motorola, this share is likely to increase even more in coming years), the Japanese presence in prediffused circuits is still not being very strongly felt, since their best prediffused circuits are going to captive demand and are therefore, for all practical purposes, not readily available on the market. Thus the Japanese have available for their own needs gate arrays with propagation times of 0.3 and 0.4 ns and a complexity of 400 to 500 gates, as well as 1,000-gate/0.5- to 0.6-ns arrays with memory on the chip for special applications.

In any case, those are gate arrays, not cell arrays. In regard to the latter type of array, which is characterized by low energy consumption and ease of customizing, the Japanese are still lagging; RTC can therefore count on a certain sheltered grace period, the more so since this company's Subilo P and Subilo N processes are well suited to the cell technology.

Motorola, RTC and Fairchild thus currently share among them most of the largest world market, namely, that of the United States. Motorola is currently offering its Macrocell I, of the cell type, internal ECL (CML [current mode logic] at RTC) and compatible 10 k ECL. The ACE 900 and the ACE 1400 can easily replace the equivalent Motorola circuits (the inverse does not hold true), but it is more to the point to compare these products under development with Motorola's future Macrocell II circuits, the characteristics of which are not yet fully known, other than their internal speed of 0.5 ns and their maximum complexity of 2,500 gates.

The Fairchild company has all the technological know-how required to do as well as RTC, but is poorly positioned as regards prediffused devices (although well positioned with respect to ECL memories). Fairchild has made several attempts these last few years, but until now has disclosed only plans as regards advanced circuits.

The Assets Needed to Succeed

In this context, RTC's ACE family appears to have many of the assets needed to succeed.

It is a family of prediffused cell arrays, not gate arrays. The cell concept, as we know, lends itself to design in two stages: Choice of the function to be performed by each cell, to begin with; then, the cell interconnections needed to actualize the desired system. The cell configuration offers the advantages of

a good figure of merit (a gain of 5 to 40 over an ECL array for the ACE family) and a wide-ranging flexibility of design, in that function sites are preset on the silicon by way of function libraries. The client thus need only be supplied with simple software to enable him to design his own system and he can customize a circuit in 15 days including definition of the masks.

Gate arrays are not faster than cell arrays but they permit much finer-tuned optimizations of chip area and internal propagation times (although the logic paths must be calculated at around "50 ps"). This is why state-of-the-art data processing sometimes prefers gate arrays.

Another advantage of the ACE line is that its peripheral stages can be configured, by masking, as input, output or input-output stages. This is a desirable feature, especially with respect to multiplexing. The current 24- and 36-cell arrays have an input-only peripheral axis and another axis that is configurable as an input, an output, or a bidirectional one. These arrays are actually versions of the company's old MLA 24 and 36 circuits with redesigned peripheries to obtain the above-mentioned properties as well as 10 K and 100k compatibilities.

Another option available to the client is ECL 10 k or ECL 100 k output compatibility, it being understood that the circuit cores are in all cases of the CML type because of this logic's advantageous figure of merit.

Lastly, the client has the option of choosing from among output circuit speeds of 0.75 ns, 1 ns or 1.2 ns, all programmable by masking. It must be remembered that it is not advisable to merely request the maximum available speed for each peripheral output, as there is the chance that this might give rise to reflections and bouncing at printed circuit levels. It is preferable to use maximum clock speed, for example, and slower fronts for the other signals.

Another advantage of the ACE line is that each cell can be commanded in three states, enabling disconnects along a common bus, for example, thus avoiding perturbations. Command is effected by operating on the transistor emitters.

Up to 400 MHz

The other advantages are in the performance domain: The first of these is the line's internal propagation speed of 0.35 ns, which is of interest to the most demanding users requiring, as a rule, speeds of less than 0.5 ns (for a divider-configured flio-flop, the input signal frequency can be as high as 400 MHz). This is owing to the company's Subilo P technology.

The figure of merit (the product of propagation time and a gate's energy consumption) does not exceed, as we have pointed out, 1 pJ. This is largely owing to the use of three levels of current switching in ACE circuits in lieu of the customary two. But the figure of merit per gate is also bettered as the scale of the circuit is increased, since in all integrated circuits it is the peripheral stages that consume the most energy. The CML internal circuits used in the ACE line moreover have a good figure of merit.

RTC further points out that its new family averages a fill factor of 70 to 90 percent, a performance that can hardly be equalled at present by competing prediffused circuits, because of dissipation problems in particular.

The 1,256-gate array will have, as we have seen, 256 RAM memory dots and 48 cells. This structure is especially suited to ALU [arithmetic logic unit]-related functions, but also, in instrumentation, to the acquisition of fast data sequences that can subsequently be processed by a slower MOS microprocessor. The ACE 600 and 900 require chip areas of 28 and 36 mm^2 respectively; these areas will be reduced by 40 percent in the near future. The ACE 2200 requires a chip area of 80 mm^2; the production yield is nonetheless satisfactory, since the density of the circuits it carries is relatively low. Later, if justified by demand, a 5,000-gate array will be developed.

ACE circuits are offered in 64-pin housings for the 600 and 900 versions, and in a 120-pin housing for the others. A 144-pin housing is under study, but for sufficiently large orders, any housing can be provided. Energy consumptions are as follows: ACE 600: 1.8 W; ACE 900: 2.3 W; ACE 1400: 3.5 W; ACE 2200: 5 W; ACE 1256: 3.5 W. Consumption thus averages between 2 and 3 mW per gate. By comparison, a standard ECL 100 k gate consumes 40 mW.

The ACE family currently has no second source, but negotiations are under way in this regard in the United States.

We note that, in 1981, RTC sold 40 percent of its ECL circuit production on the European market (mainly the French market, with its HCML line for the CII-HB), and 60 percent on the American market. In 1982, RTC expects to cover 30 percent of the noncaptive world market, all ECL circuits included.

9399
CSO: 3102/255

FERRANTI ENLARGES FAMILY OF GATE ARRAYS

Paris ELECTRONIQUE ACTUALITES in French 5 Apr 82 p 21

[Article by J. P. Della Mussia: "Ferranti Enlarges Its Line of Prediffused CML/2.5 NS Circuits"]

[Text] Ferranti, which is represented in France by ATAC Diffusion in all that concerns prediffused circuits, is enlarging considerably its catalog of CML [current mode logic] circuits using the CDI [collector diffusion isolation] technology (a technology in which the company specializes, which yields a good figure of merit, but which is suited to operating potentials of over 7 V).

This enlargement will be along three axes: The first family, designated "R/LSI," consists of 5 matrices of 500 to 2,000 gates, 2 inputs. It has been available for only a few weeks on a new-studies basis; the actualization of prototypes will be possible beginning in the second quarter of this year, and production could start by the third or fourth quarter 1982.

The second family, designated "R/VLSI," consists of two 2.5-ns, 300 μW per gate models, one of which is a 4,000-gate and the other a 10,000-gate version.

The first of these will be available on a new-studies basis by mid-1982 and the second by the end of 1982.

The third family, designated "R/subnanosecond," will consist of three models: A 1,000- , a 2,000- , and a 4,000-gate model, the first of these offering an internal speed of 0.5 ns with an energy consumption of 1.5 mW per gate, and the other 1 ns at 0.7 mW per gate. These circuits will be available for new studies by the end of 1982; the first prototypes could be made available by mid-1983.

Choice of Three Speeds

The above-mentioned first five matrices of the R/LSI series can be actualized on the basis of three speed-consumption tradeoffs. In the "high-speed" version, the delay is 2.5 ns for a consumption of 300 μW per gate. In the standard option, it goes to 7.5 ns at 100 μW per gate, and in the low-power version to 15 ns at 30 μW per gate.

The family includes models as follows: 224 cells/500 gates/40 outputs; 378 cells/900 gates/48 outputs; 504 cells/1,200 gates/56 outputs; 672 cells/1,600 gates/64 outputs; and 900 cells/2,000 gates/72 outputs.

As usual, it is difficult to compare the integration possibilities of these circuits with those of competing families without knowing how many gates or how many cells are taken up by the basic functions.

The cells of the Ferranti matrices are equivalent to 2 NOR gates, 2 inputs, and provide two electrically isolated buffer outputs. Each cell thus has 4 current sources: An elementary gate needs one source of current for its CML portion and another source for the emitter-follower buffer. It may be desirable to assign two current sources to the CML gate and to the emitter follower; the cell, in this case, can only contain a single 4-input gate at maximum, and the delay will be approximately equal to half its normal nominal value (without, however, ever being less than 2 ns). Thus, for a 7-gate load, for example, the delay for a falling front is reduced from 8 ns to 4 ns.

Ferranti also points out that with a wired OU [output unit] the response times and the number of necessary cells can be diminished.

For example, an exclusive OU occupies 1.5 cells in a Ferranti array; an RS flip-flop 1 cell; a latch with return to zero 2 cells; a D flip-flop 3 cells; a JK flip-flop 5.5 cells; an asynchronous divider by 10, 14 cells; and a cascadable D-sychronous binary counter 7.5 cells.

A library of standard interface circuits is in the process of being drawn up.

9399
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ERRATUM: This article is republished from JPRS 80906 of 26 May 1982 No 104 of this series, pp 1-2 to correct certain translation terms.

ELECTRONICS

ERRATUM: CIT-ALCATEL ENTERS CUSTOMIZED CIRCUIT MARKET

Paris ELECTRONIQUE INDUSTRIELLE in French 1 Feb 82 pp 19-20

[Article: "Alcatel Semiconductors Comes on the Scene"]

[Text] CIT-Alcatel recently gained a foothold on the market for customized circuits by creating, several months ago, Semiconductors Alcatel (SCA) following an agreement made 20 January 1981 by which it acquired 25 percent of the capital of the American company SPI (Semi Processes, Inc).

SCA, whose main interest is customized printed circuits, pure or in the form of gate arrays, has left little room in its plans for standard printed circuits: The resale of SPI's standard DMOS circuits will account for only Fr 3 million of the Fr 28 million of turnover planned for 1983, and Fr 17 million of the FR 87 million planned for 1985. SCA will study and design circuits in all technologies, but will distribute only CMOS and will subcontract other technologies at this level.

Indeed, the interest of the CIT-Alcatel-SPI agreement seems to be primarily technological in nature, since SCA is in fact using CMOS technology with 5-micron selective oxidation on SPI gate array matrices with 300, 544 and 1,000 gates, programmable by a single metallization mask. The resulting characteristics of this technology are (typical) internal propagation times of 3 to 5 nanoseconds, input of 3 to 12 volts, and a fan out of 2. This year SPI should bring out matrices with 3-micron patterns and with two levels of interconnections, but should not be followed by SCA in this field before 1984. This is for financial (and also technological) reasons. Since the designing has already started in Villarceaux, near Paris, the rest (masks, diffusion, etching) could begin this year at the neighboring Marcoussis center, originally earmarked for ECL circuits and high-reliability HF transistors; the manufacture of wafers, handled up to present by SPI in the United States, will be performed in France, in late 1983, in a new plant in Aix-les-Bains, the capacity of which should ultimately reach 1,000 four-inch wafers per week. In terms of design, the Villarceaux center is now capable of accepting 100 gate array projects a year (half for the group's needs).

The gate array prototypes will be delivered to the user between 6 and 14 weeks after the plan is submitted and production could begin within 8 weeks after the delivery of the prototype. Finally, in order better to understand this

infatuation of CIT-Alcatel (and so many others), with customized circuits, we note the company's estimates concerning the customized MOS circuit market, as follows: In 1983 the market in Europe would be Fr 2.5 billion and should increase to Fr 3.2 billion in 1985. In France the market for gate arrays alone would go from Fr 113 million to Fr 254 million for the same years, respectively.

9380
CSO: 3102/196

ERRATUM: This article is republished from JPRS 80906 of 26 May 1982 No 104 of this series, pp 3-4 to correct certain translation terms.

ELECTRONICS

ERRATUM: EEC TO FUND R&D IN INTEGRATED CIRCUIT MANUFACTURING MACHINES

Paris INDUSTRIES & TECHNIQUES in French 10 Feb 82 p 14

[Article by Jean-Francois Desclaux: "Integrated Circuits: A European 'Machine Plan'"]

[Text] Breaking the Virtual U.S. Monopoly by 1985

True independence with respect to integrated circuits presupposes two things: mastering the basic technologies and design capabilities, but also having one's own manufacturing machines. The United States is the only, or almost the only, country in this position. The European Community wants to break up this virtual monopoly. It is rallying its forces to give itself equipment capable of satisfying the objectives of the next 5 to 10 years: attaining submicronic technologies. Adopted by the EEC Council of Ministers, a "regulation" which provides for the construction of a wafer stepper between now and mid-1984 has just entered into force. The machine will have to handle 6-inch wafers, with an exposure field of 1 cm^2 and with a line-etching precision of 1.25 microns. The output will have to be about 50 four-inch wafers per hour.

Electronic maskers will have to inscribe 1-micron lines on 15 to 20 six-inch wafers an hour. The precision of alignment will reach 0.1 micron for minimum characters of 0.5 micron.

Plasma-etching equipment is defined in terms of the materials etched: doped silica, silicon nitride, polycrystalline silicon, silicides, aluminum, metals used for interconnection and resins. The performances will be on the same order as those of other links in the manufacturing chain: 1.5 micron lines and outputs of 50 wafers per hour. The community will provide 50 percent financing for projects for researching and developing manufacturing machines. These machines also include test machines and CAD machines for designing integrated circuits in the new technologies. Thus this equipment should be built by the expiration of this plan, set for 31 December 1985. It has been noted, however, that certain research centers plan to cross the micronic threshold about 1983 and accordingly they need these machines here and now.

Two Hundred and Fifty Million Francs

Funds equivalent to approximately Fr 250 million will be granted to European companies capable of meeting the specifications set more or less provisionally

by this regulation. In fact, since they date from 1980, these specifications require some updating and are still likely to be changed following the development of the first contracts planned for the end of 1982. The invitations for bids will be published shortly in the official journal of the European Community and will be addressed to established industries in the community.

9380
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BRIEFS

SGS-ATES, TOSHIBA C-MOS AGREEMENT--SGS-ATES and Toshiba have just signed a technical "cooperation" agreement designed to bolster the position of SGS-ATES in the area of C-MOS circuits. All that is known at this point is that SGS-ATES will receive the know-how necessary for two 3-micron-pattern C-MOS fabrication processes, and that the company will be able to produce all the C-MOS circuits in the Toshiba line. (This line covers C-MOS static memories, microprocessors, prediffused devices, and original logic circuits). Tuesday evening, SGS-ATES was still not in a position to provide the list of products which would be selected for mass production in Italy. Nor did the company want to reveal anything about the two technologies in question (N-MOS circuits are excluded from the agreement). Finally, there was no comment either on the nature of the agreement (acquisition of licences, or anything else), or on the investments being considered by SGS-ATES for this new operation and for the fabrication dates of the new products. It is therefore difficult to assess the significance of the agreement. There is no doubt that at present, Toshiba has one of the best, if not the best C-MOS technology in the world, at least at the 3-micron level. But will SGS-ATES enjoy the benefit of succeeding 2-micron and smaller technologies? By the time SGS-ATES is ready to produce 3-micron circuits, the industry will indeed have started to produce 2-micron ones. Finally, it must be noted that SGS-ATES is the first company in Europe to sign an agreement of this type with a Japanese company. When the first French integrated circuit plan was being prepared, negotiations did take place between French and Japanese companies, but it might as well be acknowledged now that the goal was essentially to reduce the demands of potential American partners. World leadership in semiconductors has shifted since that time. [Text] [Paris ELECTRONIQUE ACTUALITES in French 26 Feb 82 pp 1, 14] 11,023

CSO: 3102/213

FIRST FRENCH FLEXIBLE WORKSHOP PLACED INTO SERVICE

Paris ELECTRONIQUE ACTUALITES in French 7 May 82 pp 1,7

[Article by G. Bidal: "At Renault Industrial Vehicles, the First French Flexible Workshop Is Placed Into Service"]

[Text] Saint-Etienne--The first French flexible workshop was inaugurated on Monday 3 May at Boutheon, near Saint-Etienne, at the Renault Industrial Vehicles plant where truck transmissions are made. This realization, especially the fact that the workshop is controlled in actual real time, is probably a world first; therefore, it marks an important date for French automation, even though very few enterprises can afford such a top-of-the-line workshop.

This inauguration is providing French chauvinists with a unique opportunity to rejoice and shout: "We do have a flexible workshop!" Although this realization alone cannot make up for the fact that France is behind when it comes to automated workshops, it should rid the French automation industry of the technical complexes it might still harbor.

It must be recognized that, beyond the almost magical connotation which the phrase "flexible workshop" has acquired, the Boutheon machining unit for heavy-duty truck transmission casings is impressive. Judge for yourself: to machine four different types of parts, one in aluminum and three in cast iron, each including some ten secondary variations, the workshop is outfitted with seven digital control machines with automatic tool-changers: four Grafenstaden machining centers, two convertible modular machines (MMC's) and one boring-surfacing machine manufactured by SMC[expansion unknown]-Renault who was the prime contractor for the workshop. All these machines are served without any operator's intervention by eight motorized trucks guided through wires which are embedded in the floor; these trucks were made by SEIV[expansion unknown]-Automation, another subsidiary of Renault Machine Tools. This conveying system is based on a grid network which is bidirectional in all points; it is of the "taxi" type: any truck, receiving its orders through magnetic contacts distributed along the network, can transport "on request" any part along any path from one machine to another. The truck batteries are also changed automatically. The software for the transportation system was designed and realized by SODETEG [Technical Studies and General Enterprise Company].

Real-Time Control: A World First

Above all, the central control system can be considered as a world first, especially so since it operates entirely in real time. This means that each momentary event will reset the decision-making parameters, either locally or centrally (attribution of any operation to be carried out on any part supplied by any truck to any machine). It is easy to imagine the complexity of the mathematical operating model; still, the central management system installed by CERCI [expansion unknown] is surprising light: one Solar 16-40 with 128 K of memory from SEMS [expansion unknown] (with a duplicate for safety reasons). It should be noted that intelligence has been widely distributed: the system includes 25 SMC [expansion unknown] top-of-the-line programmable controllers (models 200 and 500) and 5 NUM [expansion unknown] digital controls.

Flexibility, here, should be understood in the broadest sense: flexibility as far as volume is concerned; the present investment provides for 70 casing collections per day (25 are produced today), and next year an additional investment will increase that number to 100 per day. Flexibility as far as production is concerned, since the numerous changes in production introduced after the order was placed (1979) "got through" nicely. Renault Industrial Vehicles has published an invitation for tenders for the industrialization of an additional part in the same workshop, and it is likely that Renault Machine Tools will be the successful bidder. Finally, we should mention flexibility as far as breakdowns are concerned, since the parts can be machined on either of two machining units, and since these machining units can carry out the work of the other machines, although with a slower output rate.

Forty-Five Million Francs Invested

For this first French flexible workshop, therefore, the very top-of-the-line has systematically been chosen. There remains to assess the cost, for Renault Industrial Vehicles denies that this was part of a technological pilot experiment within Renault. The project was compared with other, less flexible solutions--transfer lines or flexible cells located along a batch conveying system--and was selected because of its "strategic" profitability (it can adapt qualitatively and quantitatively to future demand). Certainly, it represents a considerable investment: 45 million francs at 1979 prices (including 6 million francs in assistance from DIELI [Bureau of Electronics and Data Processing Industry] in the form of bonus loans); this amount does not include overall research investments. Nevertheless, the solution is financially competitive for Renault Industrial Vehicles; 15 people--3 shifts of 5--are enough to ensure normal operation of the workshop, and the operating costs are slightly less than with a traditional solution, although maintenance costs are higher. The decisive advantage, however, resides in the adaptability of this tool to the market, and has not yet been measured.

Other Clients

At Renault Machine Tools, the supplier, it is expected that this first will bring in other contracts and numerous contacts are rumored to be taking place, both in France and abroad, to study other flexible workshops. Two contracts

have been obtained, one from Caterpillar in Grenoble, the other from the landing gear manufacturer Messier-Hispano-Bugatti. These projects, however, will be smaller than the Boutheon workshop since they will use a linear conveying system. But they show what few sectors are likely to be interested in an automated workshop of the Boutheon type: earth-moving equipment, aeronautical industry, industrial vehicles. Apart from these, the large investments required will probably place such a workshop out of reach of the industries most likely to be interested: small and medium-size industries producing small series. Obviously, Renault Machine Tools wish to derive from this experiment flexible solutions suitable for a broader market, but they still must prove that "he who can do most can also do less."

9294
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RENAULT PATTERN RECOGNITION SYSTEM NOW ON PRODUCTION LINE

Paris LE MONDE in French 14 Apr 82 p 14

[Article by Richard Clavaud: "A New 'First' at Renault"]

[Text] After having opened France's most robotized plant at Douai-Nord--where the R-9 car is built--Renault recently achieved another "first" in its plant at Cleon in Seine Maritime,* where a few weeks ago, a robot-equipped pattern recognition system was incorporated into an industrial production line. Housed inside a grillwork cage a few meters square, this robot, manufactured by Renault-Acma, unloads crankshafts for the R-5 and R-18 cars and places them into a transfer machine. These crankshafts weigh an average of 18 kilograms. They are stacked on two pallets positioned on both sides of the robot. The robot's "hand" grasps each crankshaft and places it on a V-shaped rack which, in turn, sets it down on the conveyor belt. When the robot has finished unloading one pallet, it moves to the other. At the same time, a signal light informs the fork-lift truck operator that he has 45 minutes--the time it takes the robot to unload a pallet holding 108 crankshafts--to bring in another full pallet.

The robot unloads one crankshaft approximately every 20 seconds, but it can work faster. This permits, for example, constitution of a "buffer stock" on the conveyor so as not to leave the transfer machine waiting for parts when the robot has to be shut down, which is the case when the fork-lift operator moves a new pallet in place.

Before this robotics system was installed, it took three workers to keep the transfer machine loaded. They handled several tons of metal per day. Removing crankshifts from the pallets was hard work for these men. But it was a simple task. For a robot, the task is extremely complicated. Officials of Renault's DTAA (Advanced Automation Techniques Directorate) told us that simple manipulators would not have been adequate for this automation. The position of the crankshafts on the pallet may vary by a dozen centimeters and their orientation by some 15 degrees. Furthermore, their direction is not defined beforehand. The robot must, therefore, show a certain degree of "intelligence" to adjust itself to this environment.

* The Cleon plant produces two-thirds of the engines used by Renault and all mechanical transmissions. Its daily output is 4,600 engines and 6,500 transmissions.

Several Stages

Renault recently exhibited a robot of the same type at the Palàis de la Decouverte [a museum of science and technology]. This robot was shown picking up a randomly-positioned part lying on a flat surface. At Cleon, the task is even more complex in that the robot is working in an industrial plant and has to grasp one item from a semi-jumbled stack. The pattern recognition system must not merely identify an object on a uniform background, but also single it out from all identical objects lying alongside it and beneath it in layers, all of them forming a background of the same color.

The pattern recognition process has several phases. An overhead TV camera mounted above the stack of crankshafts transmits an image to a computer which marks it with a series of conspicuous dots framing the ends of the parts. To ascertain whether these ends could be those of a crankshaft, the computer measures the distance between them and also their orientation. Along a line connecting two "recognized" ends, the computer then analyzes the alternating bright and dark areas that correspond to the "hollows" and "bulges" on a crankshaft.

If this alternating pattern matches the pattern of the crankshaft silhouette stored in the computer's memory, the test is deemed positive. The computer then finds the crankshaft's center of gravity and a sonar mounted in the robot's hand determines the height above the stack. The robot thus has all the data needed to grab the crankshaft.

Motion-Picture Set Atmosphere

Adjusting this system for use in an industrial plant required 6 months of work by Renault engineers. One of the problems that had to be resolved was that of the cameras. After tests with equipment produced by Philips, the engineers finally selected equipment proposed by Thomson. The latter firm succeeded in producing satisfactory results by modifying its standard 256-line industrial cameras.

Then the lighting problem had to be settled. Renault had initially tried to work in natural light. But as the seasons changed, the rays of sunlight entered the plant through different skylights, a situation which made calculations difficult. Consequently this approach was abandoned. Now the lighting is furnished by six 250-watt spotlights that create a sort of motion-picture set atmosphere.

DTAA executives underscored the importance of prehension problems. "Just as in assembly operations it is not enough to know how to insert one part into another to actually put them together, in our case it is not enough for the robot to know how to recognize a crankshaft to actually handle that crankshaft. In these two applications of robotics, the robot has to be able to grasp a part that has a complex shape." The pincers-like hand used at Cleon is "compensated" thus giving it some play. It does not close until one of its jaws has touched the object to be grasped, thus allowing a positioning accuracy of a few millimeters while avoiding any inordinate shaking of the stack of crankshafts.

This system has long been used by mechanical engineers. It requires no electronic circuits and provides an economical solution to one of the robot's dilemmas, namely how to make a pincers that has a certain flexibility while still retaining a high level of precision.

The Cleon robot appears to be operating efficiently. According to plant and DTAA officials, its current failure rate is only 0.5 percent and is expected to drop to 0.2 or 0.1 percent. Andre Lavarde, the Cleon plant's public relations officer, stressed the industrial character of the robot operation: "In this plant, we replace men with machines only when such action is economically viable."

The Cleon plant is expected to announce other innovations shortly, including installation of a tridimensional measuring machine. Automatic inspection and testing of parts will thus be an integral part of the manufacturing process.

Renault has once again demonstrated that it is capable of solving its own automation problems without waiting for the results of government research programs which the company feels have less and less connection with industrial reality. As a DTAA executive explained: "Government research laboratories have an eternity in which to do their work. Unlike them, we have a problem to resolve every day, namely how to develop in-house robots with which to build automobiles."

8041
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PROCESS FOR MAKING CERAMIC PARTS IN MOLDS

Paris INDUSTRIE & TECHNIQUE in French 10 Feb 82 p 78

/Article by Lucien Martin: "Electro-Molded Ceramics: Now, Direct Molding"/

/Text/ The melted ceramic material is drawn into the mold. The time it remains therein determines the thickness of the piece.

Alumina, silica, and zirconia based ceramic materials melt at temperatures over 1750 C. They are distinguished by remarkable pressure and abrasion resistance and by their refractory properties.

Industrial production of pieces requires the use of ovens capable of functioning at approximately 2000 C. Ceramic materials are most often poured in large masses (0.60 x 1 x 2 m, for example), then cut into pieces of desired shape and dimensions. The dimension of those blocks permits slow cooling resulting in suitable crystallization; subsequent cutting proves long, difficult, and costly.

Moreover, direct molding encounters difficulties related to the resistance of the mold, and to the nature of the binder, which imperatively must be nonreducing. Mechanical resistance remains weak at filling, either by pouring or aspiration. Because of these various limitations, high-temperature molded pieces of small size or complicated shape are not widespread.

Related to molding by aspiration, the process perfected by J. Le Clerc de Bussy reconciles the advantages of direct pouring, with a short and rectilinear feed conduit, and those of bottom pouring guaranteeing smooth entry of the liquid into the mold. Transfer of the pulverulent material above the fusion bath is assured by a boost pressure of air in the mold while the feed conduit pierces the layer, which leads to an appreciable reduction of heat losses. In that manner hollow shapes may easily be obtained, with constant or variable wall thickness, and to mold a great variety of objects such as tubes, casings, and refractory crucibles and flues of very diverse forms and dimensions. When the items to be manufactured are relatively small, however, it is advantageous to pour by clusters, and at times to include the molding of other and larger pieces so as to benefit from greater thermal inertia at crystallization. Makers and large users of insulators, who utilize these ceramics, are directly concerned in this method of production, which makes it possible to obtain finished

pieces with appreciable reduction of raw material losses, of subsequent finishing after pouring, and of energy consumption.

The fusion bed, maintained by a constant flow of the preparation to be cast, is still and constitutes an effective dome, with an oven thickness of 15 to 20 mm. The porous mold, placed in an impervious bell connected to an aspirator, has in its lower portion a feed tube with a pressure blower. Appropriate means of remote control allow the tube to traverse the bed and reach the liquid bath to a depth of approximately 10 cm. Then a suitable depression allows the liquid to penetrate the mold. It is then possible to allow the product to solidify in the tube in order to obturate it, or, to obtain hollow pieces, to allow a portion of the aspirated material not yet solidified in the mold to flow back down, while a certain quantity is already affixed to the walls. In addition, by using high pressure, some material can be pulverized on the inner surface of the mold.

In the electric oven, three molybdenum or tungsten electrodes convey energy to the center. Their position directs convection currents upward near the axis of the oven. Fusion occurs near the surface, and the bulb of melted material which forms around the electrodes does not reach the vessel wall, which is made of copper and refrigerated by a cluster of tubes.

The molds must momentarily resist very high temperatures, have sufficient porous and insulating properties to allow slow cooling, and contain no organic matter, so as to retain an oxidizing atmosphere.

In every case it is preferable that the mold be surrounded by an external metal grating to increase its resistance to hydrostatic pressure. The base, of the same material as the mold, has a connecting piece which links the interior void of the mold to that of the feed channel. The whole is supported by a metal collar insulated by a layer of Kieselguhr allowing slow cooling after molding. A spring on the upper portion constantly maintains pressure on the cover, with the mold at the base.

The entire unit is placed in a removable impervious chamber connected to vacuum and pressurized gas piping.

A Balance Monitors Filling

Once the mold is filled, it suffices to maintain the system in place and under depression for a few moments so that the liquid settles in the feed conduit, which occurs rapidly as soon as circulation is interrupted. Filling of the mold is monitored by a balance which indicates the weight of the chamber, mold, and aspirated material.

After molding, cooling is continued outside the oven to the point of complete solidification and return to a temperature allowing disassembly. Meanwhile, the chamber can be charged with another casing containing a mold to carry out a new operation. The feed conduit is formed by two removable pieces with truncated conical interior sections, joined at the point of minimal cross-section. Disassembly of two pieces permits breaking of the neck within the

conduit into two parts easily separable from the corresponding pieces.

The same materials can be used for hollow products, provided descent of the liquid is facilitated by suppression of the lid. Indeed, by interrupting the filling of the mold at the desired height, the excess liquid is made to flow towards the bath, leaving a solidified layer on the walls of the mold.

6145
CSO: 3102/197

HEAD OF AEROSPATIALE AIRCRAFT DIVISION ON ATR 42 PROJECT

Paris L'AERONAUTIQUE ET L'ASTRONAUTIQUE in French No 93, 1982-2 pp 19-22

[Paper delivered by Andre Etesse, Manager of Aerospatiale Aircraft Division, at a meeting of the Aeronautical and Astronautical Association of France and of the Association of Flying Aviation Professionals: "The Start of the ATR 42 Project and its Consequences"; date and place not specified]

[Text] I assume that you are interested not only in figures--you can find them in any good documentation--but in hearing a "story" and, if possible, a somewhat different story!

I have known different ways of launching a new aircraft: for instance, to build it, introduce it on the market, and find out that, contrary to all expectations, you could sell 500 units... but that was in the 1960's! Of course, if you consider the ever larger amounts now required to develop an aircraft, start a production run, and market it, nobody is willing to take such risks today.

Not only the "lenders" (government, banks, company boards) want to be convinced--and that is an understatement--but in practice you have to team up, to "cooperate" as they say, in order to share the risks with others and spread the commercial basis.

Finally, if we consider that the number of outlets is shrinking, i.e. the competition is increasing, we can see that it is not all roses today for the manufacturers who accepts such a challenge.

Let us now see how the Aerospatiale Aircraft Division was induced to launch a 40-50 seat twin turboprop successively called AS 30, then AS 35, then ATR 42.

On a previous occasion, I said that our approach was exemplary, for it was the Marketing Division who detected the need, and a preliminary project that could be "sold" both to the clients and to the financial departments was the result of a closely argued discussion with the Technical Division and with the production organizations in charge of working out the cost.

It was all the result of our failure, late in 1977, to revive the N.262, a 29-seat twin turboprop for which there was a large demand; for lack of credits,

we could not relaunch it and our teams started to look the world over to find out what kind of aircraft could take advantage of all the progress accomplished 20 years later--you know that aircraft technology progresses extremely fast--and, above all, could find enough buyers.

We were lucky enough to have direct access to the U.S. "commuter" market, since 26 N.262 were already in service to the greatest satisfaction of the users.

But the reason underlying our interest in such a formula was, and will remain for many years, the absolute necessity to improve fuel efficiency, either directly by using new "frugal" engines, or indirectly by improving cell design; this is where the selection of a turboprop came in.

First, we must say that, between 1970 and 1980, the cost of fuel has increased from 10 to 32 percent of the direct operating cost.

During the period 1978-1980 and, we must say, thanks to the understanding of the successive directors of civilian programs at the Ministry of Transportation, Messrs Guibe and Tenenbaum, and thanks also to research credits from our company, our Marketing Division was able to carry out reiterated in-depth market studies, and the Technical Division to meet the demand.

At the exact same time, cost studies, often accompanied with partial realizations, enabled us to determine the cost price of such an aircraft and whether we could sell it without getting in the red.

I shall spare you an account of the ups and downs of this venture in which, little by little, all our departments found themselves engaged with a fierce determination to succeed; the motto of our General Management and of Public Authorities was just one sentence:

/"Prove that there is an adequate market and that you can get positive results."/ [in boldface]

This is what has since then been called "intrinsic merits," as opposed to all repercussions which were then called "secondary merits," although they are now considered to be significant; I must briefly mention them now although, strictly speaking, they were not taken into consideration when the decision to launch the project was made.

First, in view of our position in the Airbus projects (medium capacity commercial aircraft equipped with reactors), we had to enter the field of modern propeller turboprops which would give us access to the 40-100 seat aircraft market offering a non-negligible military transportation component (Transall).

Also, we wanted our Aircraft Division--60 percent of the activity of which is represented by its large participation in the Airbus projects--to be able to carry out a global approach to a project even if, at a time, we had chosen to share this task with Aeritalia. It should be noted that, in turn, the creation of new teams, especially commercial teams, enabled us to improve our contribution to the Airbus projects.

Weights and Loads	ATR 42-100	ATR 42-200
Maximum take-off weight	14,715 kg	15,550 kg
Maximum landing weight	14,420 kg	15,240 kg
Maximum zero-fuel weight	14,105 kg	14,772 kg
Operational empty weight	9,296 kg	9,336 kg
Payload	4,809 kg	4,809 kg
Maximum fuel weight	4,500 kg	4,500 kg

Performances (under standard conditions and maximum weight)

Maximum operating speed	Mach 0.55/463 km/h	
Maximum cruising speed	513 kg/h	509 km/h
Maximum crusing altitude	7,620 m	7,620 m
Single-engine ceiling (97 percent of maximum weight, ISA [International Standard Atmosphere] + 10°C)	4,085 m	3,475 m
Balanced take-off distance (Z = 0, ISA)	950 m	1,100 m
Balanced take-off distance (Z = 1000 m, ISA + 10°C)	1,150 m	1,400 m
Minimum landing runway length (Z = 0)	895 m	950 m
Block fuel for a 185 km flight leg	273 kg	276 kg
Block time for a 185 km flight leg	32 min	32 min

The ATR 42-100 can carry 42 passengers on a 1,300-km non-stop flight, or on four 185-km flight legs without refueling. The ATR 42-200 can carry 49 passengers on a 1,450-km non-stop flight, or on five 185-km flight legs without refueling.

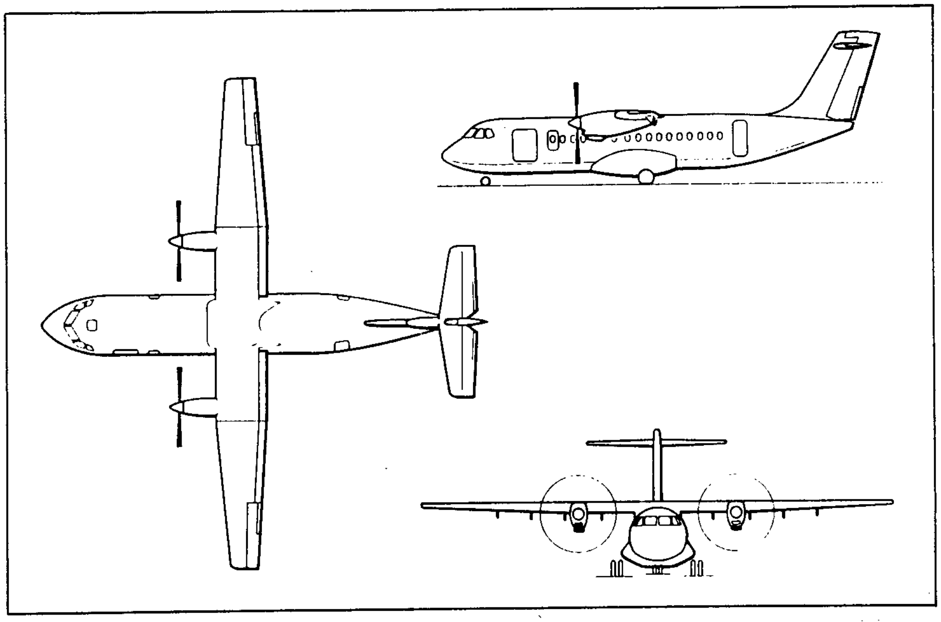
The Market

The civilian third-level commuter market has maintained itself best, whereas the annual increase for the short, medium and longhaul aircraft (the traffic of which used to increase by 6-7 percent per year during the 1970's) is now down to practically zero.

During the past few years, the annual growth in commuter traffic has ranged from 20 to 30 percent; according to various analysts, it averages 12 percent in the United States.

We must also not forget the military market which is large, first of all in France and Italy, for the Armed Forces and the Fleet Air Arms (especially with the replacement of the N 2501 and N 262).

Our market studies tally with those of several manufacturers and client companies; they show that, by 2000, the potential market for 30-49 seaters will be about 2100 units, and that for 50-70 seaters, 1700, i.e. a total of 3800; our penetration forecast leads us to estimate our share of the market at 800-1100 aircraft.



Outside Dimensions

Overall length	22.500 m
Span	24.572 m
Overall height	7.550 m
Landing-gear track	4.100 m
Passenger door (rear left)	0.750 x 1.750 m
Standard cargo door (forward left)	1.275 x 1.530 m
Door limit height	1.265 m

Inside Dimensions

Cabin length (passenger cabin + luggage compartment)	13.850 m
Maximum cabin width	2.570 m
Cabin height	1.910 m
Cabin volume	44.800 m^3
Forward luggage compartment volume	5.800 m^3
Rear luggage compartment volume	2.700 m^3
Hand-luggage racks volume	1.900 m^3

It should be noted that 40 percent of this market is in North America.

What counts is direct operating costs; on a 360-km flight leg, for 2000 flight hours per year, and with kerosene at US$1.4 per gallon, direct costs are more than 20 percent lower than those of existing aircraft (CHC 7, HS 748 and F.27/500), and more than 10 percent lower than those of aircraft now under development (DHC 8, SF 340 and EMB 120 Brasilia).

At 1981 prices, the selling price of the basic model is 5 million dollars, and the operation is out of the red by the time the 400th aircraft is sold.

It is interesting to take a look at the French market, including the Overseas Departments and Territories: 169 civilian and military aircraft, including:

- 66 F.27/227--in particular 24 at Air France (15 for the airmail service, 9 for Air Inter)

- 57 N 262.

This amounts to a market of 130-150 aircraft by the year 2000.

Characteristics of the ATR

It is an aircraft which appears to be very simple but which, in fact, is very hard to develop so as to reach the direct operating cost objective; as a result, its aerodynamic characteristics must be designed with the utmost care. We also tried to minimize a number of inconveniences having to do with comfort, such as noise (because of the propellers), or the sensitivity to gusts, which is not negligible in an aircraft which frequently goes through layers of clouds, and for which we have used Generalized Active Control.

Therefore, we have systematically used Optimum Cost Design methods; in addition, the whole plane was drafted on screen (Computer Aided Design and Computer Aided Manufacturing).

We are using new materials or modern concepts only when they do not increase the cost.

A few words about performances:

- weight: 15 tons
- range with 42 passengers: 1350 km
- speed: 513 km/h
- single-engine ceiling: 13,400 feet
- landing strip: 900 m
- landing, especially in Category II, either with two automatic pilots or with one automatic pilot and one head-up display
- no servo-controls.

Finally, a word about our competitors:

By having 4 passengers in a row, we have reduced our actual competition to the DHC 8 which, however, is at a disadvantage because of its diameter and because of "auto-competition" from the 50-seat DHC 7 and from the Buffalo for the military version.

With a 30-inch spacing, the ATR offers 46-49 seats (compared with 36 for the DHC 8), and up to 60 in its elongated version.

As far as direct operating costs are concerned, we are 25 percent better off than the F 27, and would still be 12 percent better off if the F 27 were to receive a new engine.

Everybody agrees that the ATR 42 owes its leading position on the market to its capacity, its development potential and its operating cost.

In this respect, the selection of a 1.90-m diameter across the floor, certainly due to the French military, has been decisive.

What were the main stages which led to a decision through these years of study, from 1979 to 1981?

First, an important event which enabled us to cut by half our expenditures and our risks; the similarity between our AS 35 project and Aeritalia AIT 230 project, which resulted in the ATR 42 commuter aircraft, and above all a common will at all levels of both companies, soon followed by both governments, to cooperate on this project.

A preliminary agreement was signed in 1980, then a full and detailed industrial agreement in the fall of 1981.

Without going into details, both companies agreed to cooperate and to create a small economic interest group to manage our cash flows and ensure that there would be only one sales entity.

The second stage marked a decisive turn as far as the "credibility" of our business was concerned: the 1981 Bourget show where we were able to present:

- a life-size model placing special emphasis on the comfort provided by the diameter--which is equivalent to that of a B 737--and by the luggage racks, etc. (one commuter airline signed an order on the spot).

- guaranteed performances, prices and delivery dates... for all orders placed before the commuter convention which was to open on 9 November in New Orleans.

We had also selected the engine, the 2000 hp Pratt & Whitney PT7, called P.W. 100/2, which fully met our requirements and assured us that, in 1985, we would have a fully developed engine to equip the elongated 50-60 passenger version.

And this is when we convinced both our "sleeping partners" and our first clients, who signed orders with the sole condition that the project be effectively launched by 1 November.

When I say that we convinced our sleeping partners, I should say that we first gave them cause for concern, but that there remained much to be done... in a very short time.

- In July, we imposed constraints upon ourselves; we had to:

- get 50 conditional orders,
- sign a detailed industrial agreement with Aeritalia,
- and of course receive from the governments an aid to development, to be reimbursed with each aircraft sale.

- By 31 October, we had 56 conditional orders from 14 companies worldwide (25 from U.S. commuter airlines, from a large European airline, from Finnair...).

- On 5 November, the presidents of the two companies signed an industrial agreement, but the agreement with the French government was signed only late on 6 November. On 7 November, I got on board to announce to the somewhat anxious U.S. commuter companies that the project had started.

Since then, well, we have been working relentlessly, all organizations and all Franco-Italian committees are in place; an operational group integrating all disciplines is operating in Toulouse, and the two governments are now actively preparing their agreements on procedures, especially on sales financing.

Project Schedule

June 1984: first prototype off the assembly line

August 1984: first flight of the first prototype

October 1984: first flight of the second prototype

Third quarter 1985: European and U.S. Certification according to Part 25

Fourth quarter 1985: First deliveries to airlines.

The ATR will be built in France and in Italy. The assembly line for the civilian versions will be located at the Aerospatiale plant in Toulouse, that for the rear-loading versions in Italy, at one of Aeritalia plants.

9294
CSO: 3102/276

TALBOT DESIGNS, BUILDS ROBOTS FOR IN-HOUSE USE

Paris INDUSTRIE & TECHNIQUE in French 10 Feb 82 pp 28-29

/Article signed A. P.: "Robots Lead the Samba"/

/Text/ Six welding robots, at six degrees of liberty, in service at Poissy plant.

Designed and built at the plant, these robots perform nearly 40 percent of subframe welding operations on the Samba and Horizon. The Samba subframe comprises 336 resistance welding points. In the new installation four conventional multipoint type machines perform 174 of them, and the robots 128. There are 34 points which do not lend themselves to simple automation and for the moment are still manually welded. All operations are performed on an automatic transfer assembly line fed by self-propelled overhead carriers. Transfer of body components is by mobile Atlas lifting pallets. The installation comprises 11 stations, including loading and evacuation stations and a free station intended for possible manual repair operations. Capacity of the installation was calculated at 60 vehicles per hour. A total of 12 persons, including adjusters, are assigned to this production phase. After placement of front and back floor sections begins the first welding operation, on internal sills, at two multipoint stations (66, then 44 welding points). A composite station follows, with 8 automated and 12 manual welding points, where begins the positioning of vertical joining beams. This operation is completed at a robotized station for 58 welding points and another composite station for 40 automated and 36 robotized welding points. After placement of the forward portion of the body on the line, a manual assembly station for 10 welding points is completed by a composite station for 16 automated and 12 manual welding points. The last two robots, for 34 welding points, complete the cycle. Completed subframe assemblies are then removed.

According to firm executives, installation was completed without problems. "Our robots were installed in one weekend. On Tuesday the line was functioning without difficulties. Contrarily to what I had thought, we have more trouble with conventional equipment than with robots," says Andre Moinard, production manager at Poissy. "That has enabled us to demystify the robots vis-a-vis ourselves and the maintenance personnel," adds Rene Antic, in charge of metalwork methods, who led the project.

Construction of the six Barnabe robots began in 1980. They were designed by a small team of three people and built in a specialized shop. This second generation succeeds the Anatole robot designed by the same team in 1973 and used on assembly lines for the 1307/1308 series. The latest are of "all electric" type. The Inland direct current motors have associated reduction gears.

The six degrees of liberty break down into two rotations of the terminal wrist, one arm rotation, wrist support, a limited rotary tilting of the arm, a rotation of the support in a vertical axis, and a horizontal translation movement of the whole.

The first version comprised three rotations and three translations. The new version with five rotations is more easily directed and more accurate. A microprocessor provides electronic servocontrol. Despite the weight of welding heads (about 40 kg), electric control was preferred to hydraulic. The latter was considered inferior from the standpoint of temperature adjustment, noise, leaks, and filtration. Welding transformers are housed in the rear portion of the robot and serve as counterweights. Precision of welding points is assured to a tolerance of 0.7 mm. Captors at the arm extremities control execution of the operation. The entire manufacturing cycle is coordinated by Telemecanique TSX 80 programmable automatons.

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END